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Alternative solvents - Polymers and materials

IONIC LIQUIDS AS SOLVENTS FOR THE SYNTHESIS OF ARAMIDS

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ABSTRACT

Aramids (aromatic polyamides) are polymers known for their high tensile strength and high thermal stability. The high tensile strength is a result of the rigidity of the aromatic rings and the hydrogen bonding between amide bonds of different chains. This makes them also difficult to dissolve in common solvents. For instance, for the production of the para-aramid poly-p-phenyleneterephthalamide (PPTA) a co-solvent of N-methylpyrrolidone (NMP) and calcium chloride (CaCl2) is used. The calcium chloride is a crucial component in the solvent mixture because the chloride anions occupy the hydrogen bonds of the amide groups. This allows the growing polymer to stay in solution long enough to obtain a molecular weight high enough to produce fibers for commercial use.

Recently, it has been found that ionic liquids with coordinating anions such as chloride, acetate and phosphates are able to dissolve PPTA better than the current solvent system of NMP/CaCl2. Ionic liquids are substances which are entirely composed of ions and have a melting point lower than 100 ?C. They are different to common molecular solvents and show interesting properties: low volatility, broad liquidus range and good recyclability. Ionic liquids with a coordinating anion are capable of dissolving PPTA because the anion also acts here as the active component of breaking up hydrogen bonds between the amide groups.

Because N-methylpyrrolidone has recently been recognized as a toxic compound by the European Union, its use could be under increasing regulations. Therefore, ionic liquids serve as a good alternative because they could be a greener polymerization medium and a better solvent to become polymers with higher molecular weights. So far it was successful to synthesize PPTA in trihexyltetradecylphosphonium chloride (Cyphos 101), tetrabutylphosphonium chloride (Cyphos 443 T) trioctylmethylammonium chloride (Aliquat 336). These are ionic liquids which are produced in big quantities and are commercially available.

Currently, research is still ongoing to find the best reaction parameters to synthesize aramids with an high as possible molecular weights using ionic liquids.

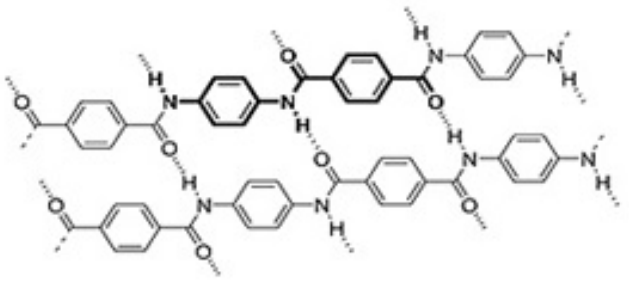

FIG1 LEGEND
Structure of PPTA

FIG2 LEGEND
Structure of Cyphos 101, an example of an ionic liquid used as solvent

KEYWORDS
Ionic liquids | Aramids | PPTA | Kevlar | N-methylpyrrolidone | Anions

REFERENCES

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